

## **REMARKS**

### **Administrative Review**

Claims 1-49, 53-56, and 68-71 were examined in the Office Action of March 18, 2008.

Claim 26 was rejected under 35 U.S.C. 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Claims 1-2, 4, 16-19, 22-25, 28-29, 36, 38-41, 53-56 and 68-69 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over R. Zheng and P. Kennedy, "Numerical Simulation of Crystallization in Injection Molding," art provided by the Applicant on the Information Disclosure Statement dated January 31, 2005, item number C118 (**Zheng**) in view of U.S. Patent No. 6,096,088 (**Yu**).

Claims 5 and 6 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of R. Byron Bird et al., "Dynamics of Polymeric Liquids," volume 2, second edition, 1987, John Wiley & Sons, pages 362-365 (**Bird**).

Claims 7 and 8 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Roger I. Tanner, "Engineering Rheology," second edition, 2000, Oxford University Press, pages 60-62 (**Tanner**).

Claims 9 and 11 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Antonios K. Doufas et al., "A Continuum Model for Flow-Induced Crystallization of Polymer Melts," art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C26 (**Doufas**).

Claim 10 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Bruce Hartmann et al., "Equation of State for Polymer Liquids," 1985, Journal of Applied Polymer Science, volume 30, issue 4, pages 1553-1563 (**Hartmann**).

Claims 12 and 13 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of F.P.T. Baaijens, "Calculation of Residual Stresses in Injection Molded Products," 1991, Rheologica Acta, volume 30, pages 284-299 (**Baaijens**).

Claim 14 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of M.A. Hulsen et al., "Simulation of viscoelastic flows using Brownian Configuration Fields," 1997, Journal of Non-Newtonian Fluid Mechanics, volume 70, pages 70-101 (**Hulsen**).

Claim 15 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Jalel Azaiez, "Constitutive Equations for Fiber Suspensions in Viscoelastic Media," 1996, Journal of Non-Newtonian Fluid Mechanics, volume 66, pages 35-54 (**Azaiez**).

Claim 20 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of A.C. Bushman, "A Continuum Model for the Dynamics of Flow-Induced Crystallization," art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C16 (**Bushman**).

Claims 21 and 43-44 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Koscher et al., "Influence of Shear on Polypropylene Crystallization: Morphology Development and Kinetics," art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C54 (**Koscher**).

Claim 26 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of B. Purnode et al., "Polymer Solution Characterization with the FENE-P Model," 1998, Journal of Non-Newtonian Fluid Mechanics, Volume 77, pages 1-20 (**Purnode**).

Claim 27 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Wilco M. H. Verbeeten et. al., "Viscoelastic Analysis of Complex Polymer Melt Flows Using the Extended Pom-Pom Model," December 2002, Journal of Non-Newtonian Fluid Mechanics, Volume 108, Issues 1-3, pages 301-326 (**Verbeeten**).

Claim 37 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of Yu et. al., "A Hybrid 3D/2D Finite Element Technique for Polymer Processing Operations," art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C92 (**Yu-Hybrid**).

Claims 3, 42 and 70 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of X. Guo et al., "Crystallinity and Microstructure in Injection Molding of Isotactic Polypropylenes. Part 1: A New Approach to Modeling and Model Parameters," art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42 (**Guo**).

Claims 30-33 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and further in view of R. Zheng, P. Kennedy, N. Phan-Thien, X.-J. Fan; "Thermoviscoelastic Simulation of Thermally and Pressure-Induced Stresses in Injection Molding for the Prediction of Shrinkage and Warpage for Fibre-Reinforced Thermoplastics," 1999, Journal of Non-Newtonian Fluid Mechanics, pages 159-190 (**Kennedy**).

Claim 34 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu** and **Kennedy** and further in view of U.S. Patent No. 6,581,473 (**Takahara**).

Claim 35 was rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** as modified by **Yu**, **Kennedy** and **Takahara** and further in view of U.S. Patent Application Publication 2002/0157478 (**Seale**).

Claims 45-49 and 71 were rejected under 35 U.S.C. 103(a) as allegedly being obvious over **Zheng** in view of **Yu** and further in view of **Kennedy**.

Without acquiescing to the rejections, Applicants hereby amend claims 1, 11, 26, 45, 53, and 54, as reflected in the Listing of Claims. Support for these amendments appears in the original specification, for example, at paragraphs [0015], [0018], [0027], [0028], [0030], [0031], [0034], [0040], [0060]-[0064], [0073], and [0077]-[0081], and in claims 18-21 as originally filed. No new matter is added.

Applicants hereby cancel claims 18-21 without prejudice, thereby rendering the rejections of those claims moot. Applicants also cancel withdrawn claims 50-52 and 57-67 without prejudice.

Applicants add new claims 72-74, reflected in the Listing of Claims. New claims 72-74 are supported in the original specification, for example, at paragraphs [0013], [0019], [0027], [0028], and [0041]. No new matter is added.

Applicants respectfully traverse the rejections and maintain that each of the pending claims are patentable over the cited art.

Upon entry of this paper, claims 1-17, 22-49, 53-56, and 68-74 will be pending.

#### **Group I claims are elected**

Applicants affirm election of Group I claims 1-44, 45-49, 53, 54-56, 68-70, and 71. Applicants cancel without prejudice the withdrawn claims 50-52 and 57-67.

#### **Information Disclosure Statement**

Applicants are attempting to locate the documents corresponding to entries C98, C104, and C106, which the Office Action indicates were not in the application files. Applicants appreciate that the remaining documents have been considered by the Examiner. Applicants are also attempting to provide dates, where available, for entries C49 and C59-C97. Any update would be filed as a Supplemental Information Disclosure Statement. The Examiner is cordially invited to contact the undersigned by telephone in the event any of this information is immediately needed.

**Claims 26, as amended, satisfies 35 U.S.C. 112, second paragraph**

Claims 26 stands rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicants hereby amend claim 26, in line with the Examiner's suggestion in the Office action on March 18, 2008, to recite a viscoelastic constitutive equation comprising "~~a FENE-P~~ finite extensible non-linear elastic model with a Peterlin closure approximation dumbbell model." Support for this amendment can be found in the specification as filed, for example, at paragraph [0031].

Applicant respectfully submits that the foregoing amendment to claim 26 overcomes the Examiner's rejection thereof. Applicants therefore request reconsideration and withdrawal of the above rejection of claim 26 under 35 U.S.C. §112, second paragraph.

**Claims 1-2, 4, 16-19, 22-25, 28-29, 36, 38-41, 53-56 and 68-69 are patentable over Zheng in view of Yu**

Without acquiescing to the rejection, but in order to advance the claims to allowance, Applicants amend claims 1, 53, and 54 to recite, in part:

...obtaining the morphological characterization using a description of crystallization kinetics of the material, wherein the description of crystallization kinetics of the material comprises an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term; ...

Applicants further amend claims 1, 53, and 54, to recite, in part:

...predicting a viscosity that is used in the process description in step (..) to characterize flow.

None of the cited references, alone or in proper combination, teaches or suggests these limitations.

Page 6 of the Office Action states that **Zheng** "*appears to teach . . . obtaining a morphological characterization of the flow of material.*" While **Zheng** may appear to obtain a morphological characterization, it does not disclose "*obtaining the morphological characterization using a description of crystallization kinetics of the material, wherein the description of crystallization kinetics of the material comprises an*

*expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term.”*

Specifically, **Zheng** fails to consider the influence that flow-induced free energy has on the morphological characterization. **Zheng**, at equation 25, appears to consider quiescent conditions, but fails to consider flow-induced free energy. Lacking the consideration of free energy, **Zheng** fails to describe “*an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term.*” By contrast, Applicant’s claimed invention considers the influence of both quiescent conditions and flow-induced free energy, resulting in a more accurate morphological characterization and therefore a more accurate prediction of a value of a property of processed material.

In addition, while **Yu** describes a method for simulating fluid flow within a three dimensional object, **Yu** fails to describe a morphological characterization in any way. Lacking a morphological characterization, **Yu** also fails to describe “*an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term.*”

Therefore, since both **Zheng** and **Yu** fail to describe a “*description of crystallization kinetics of the material*” that “*comprises an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term,*” claims 1, 53 and 54 are patentable over **Zheng** and **Yu**. Because claims 2-17, 22-44, 55-56 and 68-70 depend, either directly or indirectly, from independent claims 1, 53, or 54, Applicant respectfully submits that these claims are patentable as well. Reconsideration and withdrawal of the rejection of claims 1-44, 53-56, and 68-70 under 35 U.S.C. § 103(a) based on **Zheng** and **Yu** is respectfully requested.

On page 28, the Office Action states that **Bushman** “*appears to teach . . . the description of crystallization kinetics of the material comprises a description of flow-induced free energy change.*” While **Bushman** appears to describe crystallization kinetics using free energy, **Bushman** does not disclose a “*description of crystallization kinetics of the material comprises an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term.*” Instead, **Bushman** appears to describe the crystallization kinetics model using a strain-induced crystallization approach. This is different from Applicant’s “*expression for nucleation rate under quiescent conditions and flow-induced free energy change*” in a number of respects.

Firstly, **Bushman** does not disclose the use of a nucleation model at all. **Bushman**, in the first two sentences of the “*Strain-Induced Crystallization*” section, explains that the strain-induced crystallization approach is different from “*nucleation theories.*” Secondly, neither **Bushman** nor the “*nucleation theories*” disclose “*an expression for nucleation rate*” having “*a quiescent conditions term and a flow-induced free energy change term.*” In other words, **Bushman** and the “*nucleation theories*” do

not disclose a nucleation model that splits the contribution of quiescent and flow induced effects, as recited in the claims of the present application.

Thus, **Bushman** does not disclose “*an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term.*” Lacking such an expression, claims 1, 53 and 54 are patentable over **Zheng, Yu and Bushman**. In addition, because claims 2-17, 22-44, 55-56 and 68-70 depend, either directly or indirectly, from independent claims 1, 53, or 54, Applicant respectfully submits that these claims are also patentable over **Zheng, Yu and Bushman**.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections of the above-identified claims under 35 U.S.C. § 103(a).

**Claims 45-49 and 71 are patentable over Zheng in view of Yu, and further in view of Kennedy**

Without acquiescing to the rejection, but in order to advance the claims to allowance, Applicants amend claim 45 to recite, in part:

- (d) predicting a value of a property of the material using the morphological characterization, wherein the value of a property of the material is used in the process description in step (b) to characterize flow;
- (e) predicting a value of a property of a product using the morphological characterization, wherein the product is made from the processed material; and
- (f) performing a structural analysis of the product using the predicted value of the property of the product.

Neither **Zheng, Yu** nor **Kennedy**, either alone or in combination, teaches or suggests this limitation.

Firstly, both **Zheng** and **Yu** fail to describe predicting a value of a property of a product. While both **Zheng** and **Yu** appear to describe characterizing the flow of a material, they both fail to describe predicting a property of a product made from that material.

Secondly, both **Zheng** and **Yu** fail to describe or disclose a structural analysis of any kind. **Zheng** appears to describe simulating the formation of a product from a processed material but does not describe performing a structural analysis on that product. Similarly, **Yu** appears to describe a method of simulating fluid flow but it does not describe the formation of a product or a structural analysis of a product.

Thirdly, while **Kennedy** describes a structural analysis, **Kennedy** does not predict “*a value of a property of a product using the morphological characterization.*” More

specifically, **Kennedy** fails to describe a morphological characterization at least because it does not consider crystallinity in any way. **Kennedy** appears to describe suspended fibers, but suspended fibers are not the same as suspended crystals and are unrelated to polymer morphology. In other words, since characterizing fibers is different from characterizing morphology, **Kennedy** fails to disclose a morphological characterization. Lacking a morphological characterization, **Kennedy** is unable to describe predicting a property from a morphological characterization and subsequently using that property in a structural analysis.

By contrast, Applicant's method of "*predicting a value of a property of a product using the morphological characterization, wherein the product is made from the processed material; and . . . performing a structural analysis of the product using the predicted value of the property of the product*" provides considerable advantages over the prior art by, for example, providing more accurate predictions of both the formation of a product and the properties of the product. By accurately characterizing morphology both during and after product formation, Applicants method provides more accurate property predictions, thereby yielding more accurate structural analyses and, ultimately, more cost-effective products.

Therefore, since **Zheng, Yu** and **Kennedy** fail to describe each and every element of Applicants independent claim 45, as amended. Applicants respectfully submit that claim 45 is patentable over **Zheng, Yu** and **Kennedy**. Because claims 46-49 and 71 depend, either directly or indirectly, from independent claim 1, Applicant respectfully submits that these claims are patentable as well. Reconsideration and withdrawal of the rejection of claims 45-49 and 71 under 35 U.S.C. § 103(a) based on **Zheng, Yu** and **Kennedy** is respectfully requested.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections of the above-identified claims under 35 U.S.C. § 103(a).

#### **Remaining rejections under 35 U.S.C. 103(a)**

The remaining rejections relate only to dependent claims, which Applicants respectfully submit are patentable in light of the discussions above. None of the cited references, alone or in combination, teach all of the limitations of any of the pending independent claims.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of all rejections of the above-identified claims under 35 U.S.C. § 103(a).

**Conclusion**

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the rejections, and Applicants request allowance of pending claims 1-17, 22-49, 53-56, and 68-74 and issuance of a Notice of Allowance in due course. The Examiner is cordially invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

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